PLANT PROTECTION OVERSEAS REVIEW

SEPTEMBER

1953

Vol. 4 No. 1

COMMONWEALTH MYCOLOGICAL INSTITUTE
21 OCT 1953

PLANT PROTECTION LTD

PLANT PROTECTION OVERSEAS REVIEW

A PERIODICAL SURVEY OF NEW DEVELOPMENTS IN THE CONTROL OF PESTS, DISEASES AND WEEDS

PUBLISHED BY

PLANT PROTECTION LTD

BOLTON HOUSE, 61 CURZON STREET, LONDON, W.1

Vol. 4 No. 1. SEPTEMBER, 1953

CONTENTS

Addendum. Vol. 3, No. 4 " Plant Protection Overseas Review "

On page 34, under the abstract entitled " HELIOTHIS CONTROL IN LINSEED ", please read:

Parslow, T., Qd. Agric. J., 1952, 75 (4), 240-241.

EDITORIAL

WE publish in this number two further articles in the series dealing with the important subject of weed control in different countries. One paper traces the history of weed control in Israel and describes the present-day use of a wide range of products in the control of a number of weeds of different types in a variety of environments in that country. The second article describes the work that has been done on chemical weed control on rubber growing lands in Malaya, where this practice is relatively undeveloped but where there promises to be a great extension of the use of herbicides in the future.

The interesting story behind the discovery of what is called the " Mally Fruit Fly Remedy " by the author, and is a tribute to the late Dr. Mally of South Africa, is the subject of another article in this issue of the *Overseas Review*.

We have also published an account of cotton growing in Uganda, including the successful results of important investigations towards the control of ' blackarm ' disease by seed dressings. This paper is published by kind permission of the Editor of the A.E. & C. I. Ltd.'s magazine *Outlook*.

CHEMICAL WEED CONTROL ON RUBBER ESTATES IN MALAYA

by C. G. AKHURST

Rubber Research Institute of Malaya.

WEED control in order to increase crop yields is a very old agricultural practice. Chemical weed control is a much newer science, which has been making immense and rapid strides during the last ten years. But chemical weed control in the East, and particularly on rubber growing lands in Malaya, is relatively undeveloped.

PRE-WAR INFORMATION

In 1937 trials, which were reported in the *Malayan Agricultural Journal*, on the use of sodium arsenite and sodium chlorate for controlling lalang grass (*Imperata arundinaceae* or *cylindrica*) (Cogon grass in the Philippines), showed that sodium arsenite could be used effectively for this purpose. In the *Journal* of the Rubber Research Institute of Malaya, an account was published in 1935 of the effects of sodium arsenite, sodium chlorate, calcium cyanamide, copper sulphate and oil on lalang, grasses, and other common weeds found on rubber estates. Beyond this, interest in weedkillers died down, and not until 1946 did it awaken again.

POST-WAR SITUATION

The dense undergrowth found after the war on most rubber estates offered an immense field for weedkiller investigations, and further incentives to the use of chemical herbicides were the difficulty of obtaining sufficient manual labour and the high wage rates if hand labour were available.

Although much of the weed growth on estates was a very dense mixture of bushes and small trees, its complete eradication was not required because of the risk of leaving bare soil conditions and thereby allowing soil erosion to occur. Such areas were brought into a semblance of control by hand slashing methods. The chief use of weedkillers at this time was for controlling lalang grass which, as a light-loving weed, had invaded most of the open or unplanted land on and around estates. In many instances it was also growing amongst young rubber trees, which, when abandoned in 1942, had been insufficiently developed in size to give enough shade to prevent the establishment of lalang.

Under Malayan conditions of high rainfall, 100 to 150 inches fairly evenly distributed throughout the year, and of high temperatures, usually over 90°F, *Imperata arundinaceae* is, economically, a

very dangerous weed. It is an extremely vigorous rhizomatous grass, which spreads quickly by its feathery wind blown seeds and by fast growing stolons. The grass blades average four feet above ground, and the rhizomes are usually a dense mat for six to twelve inches below ground. Burning has little effect on the deep rhizomes, and, with other species being killed, a fire invariably results in the establishment of a cover of 100 per cent lalang. This brief review of its habits makes clear the menace that lalang can be to growers of tropical crops, and hence the prominence given to this one weed in the present article.

POST-WAR WORK

I. Lalang Control with Sodium Arsenite.

Of the newer weedkillers which had been produced during the war years, too little was known at this stage of the possibilities to make use of them, and for the time being dichlorophenoxyacetic acid derivatives, dinitro-o-cresol, isopropyl phenylcarbamate, and pentachlorphenol compounds were passed over. In any case, supplies of these herbicides were not yet available.

Even with the choice of weedkiller restricted to arsenicals, it was only possible to commence experimental work, in January 1946, by using pre-war stocks of ' tin-mine arsenic ', which were accumulations of arsenic oxide, As_2O_3, from tin smelting, and a satisfactory arsenical solution was quite easily obtained by dissolving the ' tin-mine ' arsenic in boiling water. This operation was usually done in the field by using an empty oil drum (40 gals.) in which the water was heated over a wood fire, burning old rubber branches.

The early trials with this by-product of tin smelting were repeated with sodium arsenite when this became available, and from the results were produced standard recommendations for spraying lalang with sodium arsenite, viz. apply 15 lbs. sodium arsenite dissolved in 60 gallons (Imperial) of water, per acre, at each spraying, and continue spraying at intervals of nine or ten days. Up to ten rounds of spraying were required, the number varying with the age and vigour of the lalang. In practice, the interval between sprayings increased for the later ones, and a smaller total volume of spray liquid was sufficient as the amount of regenerating lalang grew less. It was found to be an advantage to spray standing lalang and not to slash or burn it first, because once the original top growth had been killed it formed an effective mat for smothering new shoots of the grass.

This procedure has been very effective in controlling sheet lalang in the open and under young rubber trees. In open situations, a complete kill of lalang cannot be achieved and, after completion of spraying, some hand cultivation is necessary, e.g. light changkilling or forking out of individual patches where new growth appears. Under light shade formed by canopies of semi-mature rubber trees, new growth of lalang after spraying is very weak and little or no digging is required to complete its eradication.

Analyses of lalang grass which has been sprayed with sodium arsenite have given no definite evidence that any translocation occurs of the chemical into the roots, and observations on the general results of spraying confirm the view that for practical purposes sodium arsenite acts on lalang grass entirely as a contact herbicide.

Spreading Agents

The inclusion of spreading agents in aqueous solutions of weed-killers is almost a universal practice, and their use with sodium arsenite sprays has reduced the surface tension of the spray liquid very considerably and increased the effectiveness of the weedkillers. By adding 0.05 per cent. of a spreading agent to the spray liquid, the quantity of sodium arsenite required per spraying may be reduced from 15 lbs. per acre to 9 lbs. or 6 lbs. per acre when spraying lalang grass.

From 1947 onwards, estates generally in Malaya adopted the sodium arsenite spraying method for dealing with lalang. It was effective and was considerably cheaper than the traditional hand cultivation methods. Recent imports of sodium arsenite into the Federation of Malaya have been at the rate of 6,000 tons per annum, almost all of which has been used for weedkilling purposes.

Danger from Arsenicals

There are several disadvantages in using sodium arsenite as a weedkiller, the most important of which are the danger to human beings and animals, and the risk of damage to crops and the soil. Where rubber trees are growing in the area being sprayed, contact of the arsenical spray on the bark may cause a light flaking or cracking of the outer bark or cortex, but in the worst cases may produce large open wounds and a destroyed tapping panel. With normal care when spraying, such serious damage is avoidable, though, when young and small rubber plants are involved, it has been found necessary to place screens of canvas or sacking around the plants whilst the application is being made.

When applied in sufficient quantity arsenic will act as a soil sterilant, but the total amounts applied to lalang in ten spraying rounds are well below the minimum quantities (320 lbs. to 1,280 lbs. per acre) required for soil sterilisation in temperate regions. Damage to rubber trees by absorption from the soil has not been observed and would be expected to show readily as a foliage disorder. Rubber which has been replanted in an area after the completion of eight spraying rounds has exhibited no abnormalities of growth. Regeneration of other covers in areas from which lalang has been eradicated by spraying with sodium arsenite is not interfered with by any residual effects from the arsenic, and new plants appear within a month or two of cessation of spraying. Under Malayan conditions a very high degree of fixation of arsenic occurs with the average inland ferruginous soils, and laboratory tests in the Rubber Research Institute have shown that a negligible amount leaches through a column of soil. As a corollary to this, the appearance of arsenic in latex from trees in

sprayed areas is not expected, but difficulties in the chemical analysis of latex material have prevented any confirmation of this conclusion from actual analyses.

The high rate of rainfall in Malaya, whilst tending to dilute and wash out sodium arsenite from the soil, tends to produce considerable 'run-off' water which, in sprayed areas, may contain appreciable amounts of sodium arsenite, and from this arises the danger of contamination of drinking water supplies (streams, wells, reservoirs, etc.). Special legislation has been enacted in Malaya which, by controlling the use of this poisonous chemical, is intended to reduce the hazards to human and to animal life, and it deals particularly with the safeguarding of water supplies, the protection and safety of workers engaged in handling sodium arsenite, and the transport of the chemical and disposal of empty containers.

II. Lalang Control with other Herbicides

Thus, although sodium arsenite as a non-selective contact weed-killer has had considerable success in controlling lalang grass, there are several incentives to find an effective substitute. The substitute is required to be relatively non-poisonous and non-dangerous to handle, to have at least the same killing effect, to require fewer sprayings, to be at least partially translocated, and to have approximately the same cost. A wide range of chemicals known to be herbicides was therefore tested in comparison with a standard spray of 6 lbs. sodium arsenite per acre. Although results were generally disappointing, a brief summary is given below in order to indicate the scope of the treatments which were tested.

Small scale plots were used of .0167 acre or .01 acres in size, i.e. requiring one gallon of the spraying solution. Treatments were replicated and effects were assessed by allotting marks, over a range of 1 to 10 units, for the amount of browning which occurred.

The spraying machines used were usually pressure type knapsack sprayers, but when large scale trials were done by contract labour, bucket pumps were used.

1. *Sodium arsenite solutions combined with soda ash, caustic soda, sodium pentachlorphenate, sodium salt of* 2,4-D, *sulphuric acid.*

The standard amount of sodium arsenite was used, 6 lbs. per acre per spraying, with a fixed amount of detergent (0.05%), in separate combinations with each chemical listed at the following rates :

Soda ash, 12 lbs. per acre ; caustic soda, 12 lbs. per acre ; sodium salt of pentachlorphenol, 3 lbs. per acre ; sodium salt of 2,4-D (80% acid equivalent), 5 lbs. per acre.

The sulphuric acid was used at 30 lbs. per acre with sodium arsenite at two concentrations, 6 lbs. and 30 lbs. per acre. All sprayings were done at the rate of 60 gallons (Imperial) per acre, and up to nine successive sprayings were given.

The object of these tests was to attempt to increase the effectiveness of sodium arsenite by using caustic soda, soda ash and sulphuric acid, to increase the penetration of arsenic into the plant tissues, and to assess the combined or synergistic value of the pentachlorphenol and 2,4-D compounds.

None of the treatments used improved on the effect of the standard sodium arsenite treatment.

2. *Arsenic pentoxide*

Tests were made with a proprietary weedkiller consisting mainly of arsenic pentoxide. Arsenic pentoxide is fairly soluble in cold water, giving an acid solution of pH between 1.0 and 2.0, thereby increasing the ease of entry of the arsenic into plant tissues. It has been claimed that two sprayings, the first at 40 lbs. per acre and the second at 20 lbs. per acre, in 60 gallons to 80 gallons of water, would eradicate lalang.

No outstanding results were obtained.

3. *Isopropyl phenyl carbamate (IPPC or IPC)*

In temperate climates this chemical, which is almost insoluble in water, has been found to be specific in its action on monocotyledonous weeds. It was sprayed on standing lalang at the rate of 5 lbs. and 20 lbs. per acre, both as a solid (diluted with talc powder) and in solution in 65% alcohol. No observable damage to the lalang could be detected.

4. *Butyl ester of 2,4-dichlorophenoxyacetic acid*

Hormone weedkillers have had outstanding success against weeds in cereals in temperate lands, but are without much effect on plants of the grass family. A commercial formulation of the butyl ester of 2, 4-D was tested on lalang. At normal concentrations (2 lbs. to 3 lbs. per acre in 60 gallons of water) the effect on the lalang was very slight, and when the concentration was quadrupled the amount of scorching was less than with sodium arsenite.

5. *Dinitro-ortho-cresol (DNOC)*

DNOC compounds are poisonous and considerable care is required in handling and applying them. Several forms of DNOC preparations were tried on lalang. The ammonium salt in aqueous solution was sprayed using a range of application strengths up to 30 lbs. per acre in 60 gallons of water, without having any effect on lalang grass. Solutions of the sodium salt were also prepared and sprayed at the rate of 60 lbs. and 90 lbs. per acre in 50 gallons of water, the result being only a very slight browning or scorching of the lalang. Several commercial formulations, containing an emulsifiable concentrate of the sodium salt of DNOC, were applied to lalang at the recommended concentrations (approx. 1 lb. per acre of the sodium salt in 25% oil/water emulsion). From observations made on straight oil spraying tests, it was apparent that the sodium salt of DNOC added nothing to the killing effect of the oils.

6. *Oils and fortified oils*

Much attention has been given in Malaya to oil spraying for killing weeds, and although considerable success has been claimed in controlling lalang, the results seem to be difficult to reproduce.

Oils of the aromatic gas oil and the diesel fuel types have been used. The former contains a higher percentage of herbicidal aromatic compounds and is more expensive. Straight oils are similar in effect to standard sodium arsenite solutions. Usually five or six spraying rounds are required, and the regeneration of new shoots is rather slower than after arsenic spraying. The cost, however, is considerably more expensive, because about 60 gallons per acre are required to give adequate coverage on standing lalang. With straight oils, no appreciable or worth while differences could be found between the different qualities, and their effects were similar whether applied to standing lalang or lalang regenerating after slashing. The inclusion of small amounts of pentachlorphenol or of 2,4-D compounds gave no better results with lalang.

7. *Sodium trichloracetate and Ammonium sulfamate*

Of the newer, post-war herbicides, sodium trichloracetate (sodium TCA) and ammonium sulfamate (Ammate) have received extensive trial in the United States, the former for the specific control of annual and perennial grasses, and the latter as a general non-selective weed-killer. Both weedkillers are non-poisonous and relatively harmless, but are expensive and have to be used in high concentrations.

Standing lalang was killed by applying sodium TCA (60%) at 435 lbs. per acre in a single application (10% aqueous solution). Ammate was not so effective. With more dilute solutions three applications were required at intervals of five weeks, each at 90 lbs. per acre of sodium TCA (90%) to give effective control; 42 lbs. and 12 lbs. per acre per spraying were ineffective. Again, Ammate applied at the same rates was less effective than sodium TCA.

The inclusion of the sodium salt of 2,4-D (40% a.e.) at the rate of 6 lbs. per acre per spraying, with 90 lbs. TCA., showed that quite good control of lalang could be obtained with two sprayings at a ten week interval. Ammate was not so effective. Further observations in this trial were curtailed by accidental fire.

In one area, on sandy soil, standing lalang of moderately vigorous growth was completely destroyed with a single spraying of sodium TCA., 60 lbs. per acre being applied in water (about 100 gallons).

This and other observations have indicated that the effectiveness of a spraying treatment may depend on the quality, age, vigour and toughness of the weed that is being sprayed, and, in some cases, on the physical condition of the soil. Light soils favour penetration of the weedkiller, and sodium TCA can be very effective if it has direct contact with the root system. The ‘ quality ’ of the lalang is variable, and frequently cannot be assessed because of lack of information on its age and on the number of times it has been burned down by accidental fires. Hence, little can be done to allow for ‘ quality ’ when considering spraying results.

It should be noted that sodium TCA requires care in handling, and contact with the bare skin will cause blistering. It should not be

left overnight in spraying equipment, because it tends to decompose, giving an acid residue which will corrode spraying machines.

8. *Oil emulsions and fortified emulsions*

It was an obvious step, in the light of experience in other countries, to investigate the action of oil/water emulsions on lalang, and to ascertain whether synergistic effects might be obtained by including other herbicides in the oil and water phases of the emulsion. Considerable difficulty was experienced in preparing stable emulsions, and trials with laboratory preparations and commercial emulsifiable concentrates, containing pentachlorphenol, 2,4-D compounds, and DNOC derivatives gave no outstanding successes.

More recently a procedure has been developed from laboratory tests and small plot trials, which appears to give a successful kill of lalang after two sprayings and a third round of 'spot' spraying. From one to two weeks between sprayings were allowed. The emulsion is easily prepared in the field by unskilled labour, and has sufficient stability to allow its use for bucket pump spraying. Diesel fuel is used and an emulsion (15% oil in water) is prepared using ammonium oleate. The fortifying chemicals are sodium trichloracetate (2%) and sodium pentachlorphenate (1%) and spraying was done at the rate of 100 gallons per acre on lalang which was freshly regenerating after slashing.

The procedure outlined above resulted in control of lalang which was more effective than with sodium arsenite spraying, requiring only three rounds against a possible ten rounds with arsenic. The chemicals are non-poisonous and only require reasonable care in handling them. Although the materials used are expensive, in comparison with sodium arsenite, the final cost is slightly above the present cost of spraying (for ten rounds) with arsenic, and is below $200/- per acre.

The extension of this treatment to a large area (30 acres) of lalang, which was first burned and allowed to regenerate, and the employment of a Chinese contractor to do the work revealed that a much larger volume of spraying liquid was required in commercial spraying for adequate coverage, 170/180 gallons per acre being used. Also, the spraying of lalang regenerating after burning is not so successful as when slashed lalang is sprayed, because there is a much smaller leaf surface of young blades available to catch the spray, thereby reducing translocation to the roots.

Two rounds of chipping were required after spraying was completed to bring the area on to normal monthly weeding, and the total cost of the treatment by then was close to that for three rounds of hand digging.

Chemical Control of Weeds other than Lalang

The more general problem of substituting routine monthly hand weeding by the use of machine sprayed chemical weedkillers has not received much attention, and there appear to be possibilities for developing such methods in young rubber areas. If it is accepted as

desirable that young rubber trees, certainly for the first few years of their life, should be under a weeding system that provides continuous clean strips along the planting rows or contour terraces, then chemical, as opposed to manual, control of the covers which tend to invade the clean strips may offer a number of advantages, such as cheaper costs, no soil disturbance, saving in labour requirements, etc.

The method of spraying must be such that the young rubber plants are not damaged, either by direct contact with the spray or by the chemical acting in the soil on the roots, and also that only the immediately competing section of the cover is treated. Light, easily movable screens may have to be used for protection of the rubber plants during the spraying operation. Although 'low-volume' spraying would effect economies in carrying and in water usage, the drift of the very fine spray on to young rubber plants, which could not be prevented by screening, could cause considerable damage. For this reason, and because the extent to which the covers are to be treated can be better controlled, spraying of general weeds in young rubber have been done with high-volume spraying. Although in a few instances power-operated spraying from a multi-nozzled boom may be possible, difficulties of terrain, contour terraces on hill slopes, cross-drains and ditches in flat land, felled timber and old jungle tree stumps restrict spraying equipment to the simple knapsack and bucket pump types.

If mechanised operations are to be possible on all types of rubber growing land then estates must be planned and planted with this end in view. Wide spacing between planting rows must be adopted along which special contour tracks for machines can be prepared. Until these are general, mechanised spraying will be restricted to a few specially favoured and fortunate areas.

Response of different Covers to Weedkillers

The work done on the control by chemicals of covers other than lalang has not been very considerable, and sodium arsenite is as effective as anything else for killing many common weeds. The poison risk, however, prohibits the use of arsenicals in many instances, and information on the effectiveness of other weedkillers is required.

The Department of Agriculture has published a report of investigations with 2,4-D and MCPA compounds, which show the susceptibility of a number of plant species to these substances. *The Malayan Forester* (1950) gives an account of tests with 2,4-D (sodium salt) on several weeds. Trials have been made from time to time by estates and firms, and the information available is summarised in the table given below :

2,4-D compounds : Water hyacinth (*Eichornia crassipes*) was killed readily by the sodium salt (1.2% solution in water) and by emulsions of the ethyl ester (1%) ; the sodium salt was more effective. Carpet grass (*Axonopus compressus*) has been killed by the sodium salt.

Bracken or resam (*Gleichania linearis*) was readily killed by the sodium salt (30 lbs. per acre) and the creeper, *Mikania scandens*, was completely killed by the sodium salt (0.3% solution in water).

Unaffected by 2,4-D, sodium salt, are Bamboo, lalang, bertam, sensitive plant (*Mimosa pudica*), water grass (*Hymenachne myuros*), *Eleusine indica* and *Cyperus rotundus*.

The 2-methyl-4-chlorophenoxyacetic acid, 4 lbs. per acre, (' Methoxone ') has effectively killed *Mimosa pudica*, but did not affect carpet grass.

2,4,5-T compounds : Siam weed (*Eupatorium odoratum*) was readily killed by the sodium salt, 0.1% solution ; rubber seedings were only partly ' defoliated ' by 1% solution.

Sodium trichloracetate : *Mikania scandens* was killed when sprayed with 1% solution ; the fern, *Nephrolepis biserrata*, was severely scorched, and partly killed, by TCA at 10% strength ; Carpet grass (*Axonopus compressus*) was killed by 10% solution.

Bracken (*Gleichania linearis*) was unaffected by 10% solution, and Straits rhododendron (*Melastoma polyanthum*) was only mildly defoliated.

Ammonium sulfamate : the effects of Ammate somewhat similar to those of sodium TCA, *Mikania scandens* and *Nephrolepis biserrata* being readily killed.

Sodium arsenite : plants which can be killed at standard strengths in one or two sprayings are bracken (*Gleichania linearis*), stagmoss (*Lycopodium cernuum*), *Pteris longifolia* ; the following may only be heavily scorched without being killed : *Mikania scandens*, *Axonopus compressus*.

Conclusion

Certain of the newer herbicides have been tested to varying degrees in Malaya. Very little work has been done with some, such as isopropyl phenylcarbamate, dinitro-o-cresol, and pentachlorphenol. More detailed comparisons are required between the various derivatives (e.g. amines and esters) of both 2, 4-dichlorophenoxyacetic acid and 2, 4, 5-trichlorophenoxyacetic acid. There are a number of compounds which have not been used at all, such as sodium isopropyl xanthate, sodium 2 : 4 dichlorophenoxy ethyl sulphate, 3-p-chlorophenyl-1, -1-dimethylurea (CMU), etc. Methods of formulation require investigation, in particular the mixing of weedkillers and synergistic effects. In this connection, much more needs to be known about the mechanism of the ' killing ' of the weed.

Excessive concentrations of a contact herbicide may produce such a rapid destruction of the green aerial portions of the plant that a hormone weedkiller, which requires to be translocated, may be rendered ineffective by the unduly rapid ' burning ' of the plant tissues. Continued use of a selective weedkiller may result in the establishment of a resistant plant species, which in turn will become

a weed problem. It is not beyond the bounds of possibility that an immunity to one type of herbicide may be built up in the plant, and thus a rotation of weedkillers may become necessary.

The use of 'pre-emergence' weedkillers is an attractive prospect for closely planted nurseries and for newly planted clearings.

Finally, there is always room for refinement in determining the optimum quantities to use, the best time to apply weedkillers and the most economic method of application.

It should be clear from the preceding remarks that little more than the fringe of problems relating to chemical weed control has been penetrated in Malaya. The work that has been done, however, holds every promise for a great extension of the use of herbicides in the future.

REFERENCES

(1) C. G. Akhurst. Use of weedkillers in Control of Natural Covers, J. of Rub. Res. Inst. Malaya, 1935, **6**, 111.

(2) J. L. Greig. The Use of Chemicals for Eradication of Lalang Grass, Malayan Agr. J., 1937, **25**, 363.

(3) W. W. Robbins, A. S. Crafts, and R. N. Raynor. Weed Control, McGraw-Hill Book Co., Inc., New York and London, 1942.

(4) R. B. Jagoe and M. Johnston. The Use of Plant Growth Regulating Substances as Weedkillers, Malayan Agr. J., 1949, **32**, 304.

(5) Anon. Trials of 2,4-D (Sodium Salt) in Control of certain Forest Weeds, Malayan Forester, 1950, **13**, 95.

A FRUIT PROTECTION MEASURE IS BORN

A Tribute to the late Dr. C. W. Mally

By A. B. M. WHITNALL, M.Sc., F.R.E.S.,
Chief Entomologist
African Explosives and Chemical Industries, Limited

ALL fruit farmers know of the Mally Fruit Fly Remedy. It has had vast repercussions on fruit farming in this country (South Africa) as well as in other fruit producing areas of the world. It is a simple but effective remedy, and the story of its development goes back many years.

Dr. C. W. Mally was born in America and spent his early life there. Like many other schoolboys he liked to tease his companions. Mally's particular method was to dip his fingers into puddles made from melting snow and then flick the ice cold water into the face of his victim. Little girls as well as little boys were treated in this manner.

Mally was a dutiful son, and would often help his mother with housekeeping duties. One day he was given the task of stoning raisins. Seated at a table near the kitchen window young Mally found it difficult to keep his mind entirely on the job. He watched the house flies walking about the window panes, and noted how most ignored the liquid poison bait placed in a saucer on the table. One fly, however, alighted on the saucer and partook of the poison, lapping it up with its proboscis. This fly was soon in its death struggles, and Mally watched fascinated. If only more flies would come to the poison bait, it would not be long before they were all dead. But why not give the poison to the flies, rather than wait for the flies to come to the poison. Mally watched them crawling up the window, and almost unconsciously his hand went out and the fingers dipped into the liquid in the saucer. A little flick and, droplets of the sweet poisoned liquid appeared on the window panes. Here the flies readily found them and began to suck up the poison. It was not long before many dead flies were lying on the ground. The budding entomologist was roused from his speculations by a shout for stoned raisins. There were only a few of these and young Mally was scolded by his mother. He applied himself to his work with renewed vigour, but still had an eye for the flies on the window. He noticed that even when the droplets of poisoned water had dried out and left a stain on the window, flies would still probe the spots and the poison was still effective.

One hot South African summer day in 1904, entomologist Mally was visiting fruit farmers in the Eastern Cape. He had been shown some lovely appetising peaches but all had revealed a writhing mass of maggots when opened. They were the maggots of the fruit fly, a pest which was engaging the attention of the young entomologist newly appointed to Grahamstown. Jogging along in his cart, for there were no cars in those days, the young man kept on turning the problem over in his mind. The flies had to be prevented from laying their eggs in the ripening fruit. Net coverings for the trees were expensive. What was wanted was some cheap and easy method of destroying the flies. The horse stopped at a gate near an orchard, and the entomologist was jerked out of his reverie. As he climbed out of the cart he noticed a fruit fly sitting on a leaf of a nearby tree. Mally had a headache but he could not help watching the fly. If that is how the fly wanted to take its food, then Mally could supply it. His fingers curled up to be gripped by the thumb—flick. A whole sequence of thoughts ran through his mind—ice cold water—little girls faces—stoning raisins—dead flies, dead flies, dead flies. The headache was gone and by the time he arrived at Mr. Wallace's house at "Collingham Tower" in his quietly jogging cart, entomologist Mally had worked out many a scheme he would try in his campaign against the fruit fly. He would make a sweetened bait with water, sugar and arsenate of lead and, instead of using fingers to apply it, he would use a white-wash brush to sprinkle the poison on the foliage of the peach trees, and on that of other trees surrounding the orchard.

Mr. Wallace readily co-operated with Mally in these experiments, and they proved successful beyond their wildest dreams. Later they became so confident of the method that Mr. Wallace gave a guarantee when selling his peaches, "Free from Maggots !" It was an unheard of guarantee in those days. The efficiency of the method was proved to Cabinet Ministers who visited the Eastern Cape. They were entertained to a picnic lunch on the hills near "Collingham Tower." The party was much impressed with the wonderful view, for some of the vastness of Southern Africa could be seen from these hills. Peaches were offered to the Ministers from a tray of luscious fruit. "No thank you, they are always full of maggots." "I will give you 10*s*. for every peach you find with maggots !" said Mr. Wallace. Both he and Mally had some anxious moments but, none of the party found a peach with maggots in it. The fruit protection measure received ministerial blessing.

Poison bait spraying is still the most effective known method of fruit fly control. Arsenate of lead can still be used as the active ingredient in the bait. Sodium fluosilicate is also effective. Recent experiments have shown that parathion can be used. This is particularly effective against melon flies. New poisons may come, but the Mally Fruit Fly Remedy remains basically the same.

COMMERCIAL WEED CONTROL IN ISRAEL

By S. J. ELLERN, B.Sc., Agric.
(*on staff of I.C.I.* (*Israel*) *Ltd.*)

HISTORICAL BACKGROUND

HISTORICALLY, the progress of commercial weed control in Israel can be conveniently divided into three periods:

1. The period from the earliest historical times up to the middle thirties of the present century, during which cultural practices and crop rotation were the only feasible means of control.

2. The period from the middle thirties to 1946-47, during which chemical control methods were introduced, notably Sulphuric Acid and Sodium Chlorate.

3. The period since 1946-47 characterised by the development of the " hormone " weedkillers for use in cereal fields followed by a rapid succession of new weedkillers and methods of applying them.

The first period is chiefly remarkable for the fact that for about 2,500 years methods did not change much from Bible times (1, 2, 3). Jeremiah's admonition " Break up your fallow ground, and sow not among thorns " (Jer. 4 : 3) sums up the method of weed control for this period. Crop rotation and cultivation and sowing after the rains, as practised by the Fellah to-day, control winter weeds in cereal fields remarkably well (11). The laborious deep trenching method called " Bahar " preceded the planting of vineyards and orange groves right into recent years in order to meet the danger of infestation of orchards and vineyards by Bermuda Grass (*Cynodon dactylon*) and other perennial weeds.

The second period certainly meant progress and demonstrated the economic value of chemical weed control in cereal fields and vineyards, but war conditions and technical disadvantages (fire hazard of Sodium Chlorate, corrosion of machinery by acid) prevented their widespread adoption (5, 6, 7).

The third period was ushered in by widespread co-operative trials using ' Agroxone ' for the control of weeds in winter cereals. The outstanding success of ' Agroxone ' (8) gave chemical weed control in Israel a flying start from which it has never looked back. Thanks to the timely arrival of low volume spraying by aeroplane (9), 6,000 acres of cereals alone were treated between December, 1949 and February, 1950. The present status of commercial weed control in Israel may be usefully considered from the point of view of the chemicals used.

THE OLDER "SELECTIVE" MATERIALS

Sulphuric Acid, Kainit, Iron Sulphate and Cyanamide were used in co-operative trials by the Jewish Agency Settlement Dept., Extension Division in 1939 (7). As in similar trials in Europe, all except Sulphuric Acid were not certain in action, and the corrosive nature and unpleasant handling qualities of Sulphuric Acid as well as wartime scarcity restricted its use on cereals. After the war the "hormone" weedkillers proved superior, being cheaper, less objectionable in use and not so easily affected by rain following application.

Cyanamide may be of some use to control charlock in peas, but on cereals none of these materials are used at present or are likely to be used in future.

SOIL STERILANTS

Avni's work on vines with Sodium Chlorate (5) has been referred to. This has not been generally adopted because of the danger to the vines. 'Weedicide' (Sodium Arsenite) has been used only to a small extent because of the danger to livestock and children, and offers best prospect for soil sterilisation to prevent danger of fire around open air stores and factories difficult of access. Recent work by Cohen of the Plant Protection Dept. shows good results from the application of Sodium Arsenite and/or Sodium Chlorate along irrigation pipes, where control of weeds by cultivation is difficult. Sodium Chlorate and 'Atlacide' have been used for spraying canal and river banks in autumn with success, but care must be taken not to contaminate irrigation water.

Borax has been used on a small scale only, e.g. in experiments on sugar beet control not yet summarised, but there seem to be good possibilities for the use of Borate-Chlorate soil sterilants where prolonged soil sterilisation is required.

THE "HORMONE" GROUP—MCPA

The first material of this group was 'Agroxone', formulated as a 10% liquid and 1% and 5% powders, introduced by I.C.I. (Levant) Ltd. after co-operative trials in 1945/6. While the material proved outstandingly successful for the control of broad-leaved weeds in winter cereals, such as wheat and barley, and possessed none of the disadvantages of the older selective herbicides, application became feasible on really large areas only by means of spraying from aeroplanes. Spray application by ground equipment is developing gradually, only 10 low volume sprayers having been built by growers between 1949 and 1951 when low volume spray was first applied from jeeps. Gear pumps and by-pass valves are now being manufactured locally, and nozzles imported from the U.S.A. under the aegis of the Plant Protection Department. An increase in the number of tractor-mounted sprayers of this type may, therefore, be expected.

The 1% powder, capable of application by fertilizer drill, was popular at first, but, by 1950, 5% powder was applied by motor dusters in preference, cost of material being cheaper and less transport being required per acre.

2,4-D

A U.S. product containing 40% acid equivalent (Kathon M-7) was at first found to be cheaper and more convenient for use in aerial spraying operations than 'Agroxone' 30% because of its higher concentration, but 'Fernimine,' having the same acid equivalent content, proved equally good. Lately, after at least one case where 2,4-D checked the growth of a field of Mulga oats treated with it, there is a tendency to use 'Agroxone' in preference to 'Fernimine' or Kathon M-7 on crops like oats, maize and flax which are sensitive to 2,4-D.

CROP DAMAGE

Where this occurred, it was due to: 1, wind drift of dust or spray, but especially dust; 2, accidental discharge of material; 3, errors in the user's store, weedkiller being mistaken for insecticides etc. The remedy is obvious in the case of drift, but the limitation of treatment to the windless hours of the day is a drawback to this group of weedkillers. It can be partly overcome by ground sprayers which are least affected by wind drift. Serious crop damage in Israel occurred only on vines adjoining an infinitesimal part of the cereal crop acreage safely treated and was definitely avoidable. A warning colour for the container or the material may be useful for avoiding errors in the farmer's store.

NUTGRASS CONTROL

Earlier work on this weed in Israel was not conclusive. One paper (2) tends to show that hormone weedkillers were not altogether satisfactory from the commercial point of view because of regrowth from bulbs buried in the deeper layers of the soil. Another (13) describes Rehovot work in which hormone and other weedkillers gave satisfactory results both in the laboratory and in the field. Recent work on infested land has led to the Plant Protection Dept. tentatively recommending a combination of repeated, gradually deepening ploughings, carefully timed irrigation to stimulate regrowth, and sprayings with heavy doses of hormone weedkillers as well as discing to kill the plant. Should this succeed on a large scale, then this group of weedkillers may solve another difficult weed problem of the region.

PASTURE AND SUMMER CROP

The application of weedkillers during the rainy season to heavy soils to be cropped with maize or other summer crops as a substitute for cultivation has been described elsewhere (9,13). 'Fernimine' or similar weedkillers can be economically applied by aeroplane when the ground is too wet for cultivation, thus keeping the field clean and cutting out late cultivations and consequent loss of crop.

On hill pasture improvement, which is an important field to the economy of the country, ester formulations of 2,4-D have been used for brush control in West Galilee (combined with burning) (20),

whereas in the Carmel Range, *Cephalaria syriaca* and other broad-leaved weeds were suppressed to enable useful indigenous grasses (e.g. *Hordeum bulbosum*) to develop (see tables).

OTHER SELECTIVE SPRAYS

DNOSBP was first tried in 1949 in the form of " Dow Selective " and ' Sinox W ' containing 13.7% and 13% respectively of the ammonium salt (15). It was highly successful on vetch and peas, but damaged the more sensitive legumes (e.g. Fahli clover) rather easily. Wider experience showed that, as in the United States, the treatment is very dependent on the weather (it needs high temperature, absence of cloud and of dew on the plant) for its success. It is also rather expensive for field crops, but this cost can be borne by such crops as vetch for seed. The fact that the treatment gives beneficial results only with great care in application is a drawback and so far restricts its use.

The same applies to ' Supersinox ' and ' Aerocyanate ' on onions, but the vegetable growers being more used to spraying, and onion weeding by other methods being very expensive (16), ' Aerocyanate ' especially has become surprisingly popular. Application at the correct stage of the crop is essential, as is accurate calibration. Exceeding the concentration recommended even by a little may burn the onions badly, whereas insufficient material gives poor or no weed control.

PRE-EMERGENCE SPRAYS

Both the phenols (' Kanex,' dinitro materials) and Fortified Kerosene are rapidly being adopted, and the season's results are most encouraging. The use of overhead irrigation to produce a smooth crust free from cracks or clods before applying the spray, and the need not to disturb the soil afterwards, are points essential to the success of this type of treatment (17). After germination, the use of shield sprayers permits the use of the same materials as directed sprays in such crops as onions. However, such treatment should replace hand hoeing only, mechanised cultivation between the rows being cheaper than chemicals except on wet land.

OIL SPRAYS

Large quantities of weedkiller oils, usually fortified with phenolic compounds, are used in Israel. Most of these are used in orchards under irrigation and along ditch banks where Bermuda grass (*Cynodon dactylon*) and Johnson grass (*Sorghum halepense*) are great problems. The high cost of repeated oil treatments can be countered in part by using emulsions, and by gradually reducing the volume per acre as the infestation comes under control. However, while this may apply to high-yielding and valuable irrigated crops and to irrigation systems, soil sterilisation will prove attractive where the sterilant does not endanger the supply of irrigation water, (e.g. concrete lined channels), as one treatment will often last over a long period. On roadsides, hormone weedkillers which remove the unsightly, prickly

(*continued on page* 25)

SUMMARY

The following summary shows the commercially established weedkilling treatments adopted in Israel to date :

Herbicide	*Crop or other Place of Application*	*Weed(s)*	*Rate of Application per Hectare*	*Remarks*
1% 'Agroxone' (MCPA) or Chloramine (2,4-D) dust	Wheat, Barley, Oats, Rye, Lawns	Broad leaved easy to control weeds PP categories I and II	180 kgs.	Appl. by fertilizer drill.
Ditto, 5% dusts	Ditto.	Ditto.	45 kgs.	Applied by motor duster or in nitrogen top dressing.
'Agroxone' 3 (MCPA) spray. 'Fernimine' (2,4-D amine) spray.		Broad leaved weeds, easy to control (categories I and II)	3.0 litres of 'Agroxone' or 1.2 litres of 'Fernimine' and upwards.	In high or low volume of water down to 35 litres/ha.
		Ditto. After dry weather or late-season spray.	4.0 litres of 'Agroxone' or 1.6 litres of 'Fernimine' and upwards.	Ditto.
'Agroxone' 3 (MCPA) spray. 'Fernimine' (2,4-D amine) spray.		Weeds hard to control e.g. *Anthemis* etc. Cat. III.	4.5 litres of 'Agroxone' in preference to 1.8 litres 'Fernimine' and upwards.	In high or low volume of water down to 35 litres/ha.
'Agroxone' 3, 'Fernimine'	Maize, Wintersome (irrigated fodder)	*Portulaca oleracea*, *Amaranthus graezicans*, *A. retroflexus* and others	4.0 litres of 'Agroxone' and upwards in preference to 1.8 litres of 'Fernimine' and upwards.	Selective spray.
Ditto.	Ditto. (pre-emergence)	Above weeds and germinating grasses, e.g. *Echinochloa Digitaria*.	5 litres of 'Agroxone' or 2.4 litres of 'Fernimine'	Pre-emergence spray following good spray irrigation after sowing.
2,4-D amine spray.	Wet land to replace cultivation for summer crop, e.g. maize	Broad leaved weeds (*Sinapis*, *Beta* etc.)	2.5 litres in 50 litres of water.	Applied 6 weeks before sowing or more, by aeroplane.
'Fernimine' spray.	Fallow land being prepared for irrigation.	Nutgrass (*Cyperus rotundus*).	(Experimental) 10 litres, combined with cultivation and irrigation.	Repeated treatments during summer.

Herbicide	*Crop or other Place of Application*	*Weed(s)*	*Rate of Application per Hectare*	*Remarks*
2,4-D ester (U.S.)	Hill pastures, to enable grasses to regenerate or prepare for sowing.	Brush (*Pistacia vera*, *Pistacia atlantica*, *Rhamnus* spp. *Poterium spinosum*).	3 litres in 50 litres of diesel oil	Applied from aeroplane, before and after burning.
'Femimine' or similar spray.	Hill pasture to regenerate *Hordeum bulbosum* etc.	Broad leaved, e.g. *Cephalaria syriaca*	1.5.—2 litres.	Applied from aeroplane.
2,4-D ester spray (U.S.)	Hilly land due for stone clearing.	Thorny and spiny, Compositae and broad leaved weeds generally.	3—4 litres of ester in 30—40 litres of water.	Before burning. Applied from aeroplane.
		SOIL STERILANTS		
(*a*) Sodium Chlorate, applied dry or as spray.	Soil sterilisation along fences, ditches, irrigation pipes and around stores.	All vegetation.	(*a*) 150—700 kgs.	Needs addition of 'Agral' or other spreader.
(*b*) 'Atlacide' spray (fire-proof Sodium Chlorate).			(*b*) 200 kgs. upwards.	Ditto.
(*c*) 'Weedicide' spray (containing Sodium Arsenite)			(*c*) 1—2% strength in water to give 200 litres of 'Weedicide' per hectare or more.	
		SELECTIVE DINITRO AND OTHER MATERIALS		
DNOSBP spray.	Vetch, lucerne, peas (dun and Alaska) Cyprus vetch (*Lathyrus ochrus*), Fenugreek and *Trifolium alexandrinum* (Berseem). (Selective spray).	Common broad leaved weeds.	75—100 litres in 150 (experimental) or 500—1,000 litres of water.	ConcentrationofDNOSBP varies with temperature. Beans and Fahli-clover can be sprayed but may be damaged more easily. Correct stage of crop and weed is most important.
	Onions, 12.35 cm. high, gladioli (Selected spray).	As above.	Ditto.	

Selective Dinitro and other materials—*continued.*

Herbicide	*Crop or other Place of Application*	*Weed(s)*	*Rate of Application per Hectare*	*Remarks*
"Super-Sinox"	Onions, gladioli (selective)	Common broad leaved weeds.	3.4 litres in 800 litres of water.	Spray onion at 3 leaf stage, never when leaves are bending down or broken, and use no more than 60—70 lb./sq. in. pressure.
"Aero-Cyanate"	As above.	As above but not *Fumaria* or *Gallium.*	7.5—12.5 kgs. 4—5 days after germination, or 20 kgs. at 3 leaf stage in 800—1,000 litres of water.	Low pressure essential (see "Super-Sinox"), and weeds must be small.
Special Kerosene, e.g. Shell No. 9 Oil.	Carrot, parsley, dill, celery (planted).	Almost all germinating weed seedlings.	800—1,200 litres.	Varies according to batch. Test first on small scale.

GENERAL CONTACT AND PRE-EMERGENCE HERBICIDES

(*a*) Sinox P20. (*b*) 'Kanex' (*c*) Shell oil No. 7.	Pre-emergence weed-killing on large seeded crops (peas, beans, ground-nuts) bulbs and tubers (potatoes). Also before planting vegetables, e.g. onions.	*Amaranthus retroflexus, A. graezicans, Portulaca oleracea,* and others of irrigated land including grasses.	(*a*) 30 litres in 1,000 litres of water. (*b*) 40 litres, plus 60 litres diesel oil, in 1,000 litres of water. (*c*) 250 litres pure or emulsion (see below).	
Fortified Kerosene Oil spray (contains aromatic compounds).	Pre-emergence small seeded vegetable crops.	All emerging weeds except *Umbelliferae.*	500 litres	Cuts out need for selective sprays on onions in early stages. Expensive but popular.

General Contact and Pre-emergence Herbicides—*continued*

Herbicide	*Crop or other Place of Application*	*Weed(s)*	*Rate of Application per Hectare*	*Remarks*
Fortified sprays, containing 'Kanex' or DNOC (Shell No. 6 and 7).	Ditches, road-sides, around stores, orchards and vineyards.	Nearly all weeds, esp. *Cynodon dactylon* and *Sorghum halepense.*	750 litres of pure oil or 150—500 litres made up to 1,000 litres of spray with water and 'Agral' 0.4% or other spreader or emulsifier.	Needs up to 10 applications in 1st season, less later; very expensive. Use low volume application and spot treatment.
Fortified Oil Emulsions, containing oil and DNOC or 'Kanex' in water plus 'Agral'.	As above.	As above.	1,500—3,000 litres.	Quantity decreases after 1st season. Much cheaper than pure oil.
GRASS KILLERS				
TCA, dry or spray.	Gardens, tree nurseries and gaps in orchards prior to planting	Perennial grasses e.g. *Cynodon dactylon, Sorghum halepense.*	150 or more kgs. in 1,000 or more litres.	Lower dosage effective only in wet soil. Apply with watering can in gardens.
IPC spray	Legumes.	*Phalaris paradoxa.*	5—10 kg. active material.	Experimental.
IPC dust.	Pre-emergence.	Barley aftermath and other emerging grasses.	10—20 kg. active material, worked into surface soil.	Ditto.

Compositae, if not the graminaceous weeds, are now becoming attractive because of their cheapness, in spite of possible danger to crops. Application is by low volume knapsack sprayers, used by trained operatives.

GRASS KILLERS

TCA has been successful on plots intended for tree nurseries infested with perennial grass weeds and in gardens, e.g. on paths surrounding lawns, or where it was desired to kill a Bermuda grass lawn quickly without giving it a chance to spread into adjoining plots.

Its chief disadvantage is its high cost and the failure of treatments if the soil is not uniformly wet to the depth desired, or if rains or irrigation water wash the acid out after treatment, but before it has had time to act on the grass roots.

IPC may solve some graminaceous weed problems which do not yield to other treatments, such as *Phalaris paradoxa*. However, the cost of IPC may rule out its use on field crops and changes in the crop rotation have been suggested as offering a solution (18, 19).

REFERENCES

(1) Genesis 3 : 17-18.
(2) Isaiah 5 : 6.
(3) Jeremiah 4 : 3. 12 : 13.
(4) Job 31 : 38-40.
(5) Avni, J. Control of Bermuda Grass by Sodium Chlorate, Hassadeh 20 (3) : 1, 51, 1940.
(6) Zohari, M. Weeds of Palestine and their Control. 127 pp. (illustr.), Hassadeh Lib., Tel-Aviv, 1942.
(7) Carl Cossman. Experiments to Control Weeds in Cereal Fields. Hassadeh, 22 (1), 1941.
(8) Palti, J. Weed Control in Cereal Fields by Hormone Preparations. Hassadeh 27 (2-3) : 54, 1946.
(9) Palti, J. and Ellern, S. J. One Year's Agricultural Aviation in Israel. World Crops 3 (3) : 104, March 1951.
(10) Cohen, G. Cereal Weed Control in the Winter Season, 1949-50. Hassadeh. 30 (12) : 720, 1950.
(11) Elazari-Volcani, I. " The Fellah's Farm," Hassadeh Library, Tel-Aviv, 1930.
(12) Cohen, G. Control of Nutgrass by 2,4-D, Hassadeh 32 (1) : 45, 1951.
(13) Lahover, D. and Hurvitz, S. Ways of Controlling Nutgrass, Hassadeh 30 (12), 718, 1949.
(14) Cohen, G. Herbicidal Sprays to Replace Winter Cultivations, Hassadeh, 33 (3) : 174, 1952.
(15) Cohen, G. The Influence of Ammonium DNOSBP on local Weeds and Crop Plants. Hassadeh, 31 (2-3) ; 115, 1950.
(16) Cohen, G. Estimated Costs of Weed Control Treatments. Communicated, 1952.
(17) Beeri, Y. The Control of *Phalaris paradoxa*. Hassadeh, 31 (8) : 374, 1951.
(18) Gilead, H. The Place of Vetch in the 3 Year Rotation. Hassadeh, 31 (7) : 316, 1951.
(19) Naaveh, Z. Interim Report at Hill Pasture Rally. Neve Yaar Expt. Station, 1952.

COTTON GROWING IN UGANDA

by J. M. POTTIE

Hawthorndale Laboratories, Imperial Chemical Industries Ltd.

Republished by kind permission of the Editor of "*Outlook*," African Explosives and Chemical Industries Ltd.

On first sight, the visitor to Uganda will almost undoubtedly be struck by the seeming confusion and haphazard state of the agriculture in the Protectorate.

Gone are the neat fields, fences and other orderly characteristics of European-type farming; in their place is something quite different and worthy of considerable study.

If the visitor cares to leave his car by the roadside and travel on foot or by bicycle along the many paths and tracks that twist and turn amongst the native "shambas" or small holdings he will certainly be amazed at the variety of crops grown in the 'pocket handkerchief' sized plots scattered near and around the grass-thatched mud huts of the cultivators.

Cotton is one of these crops and has been grown commercially in Uganda for almost fifty years, the type being of the American Upland group with a lint length of about $1\frac{1}{8}$th to $1\frac{3}{16}$ths inches and of good medium quality. The main varieties grown today are BP 52, S 47 and N 17.

Economically, the cotton crop of Uganda is an extremely important one to East Africa and to the British Commonwealth as a whole, especially in these days of dollar shortages. After India, Uganda has the largest cotton production within the British Commonwealth, its annual production of around 350,000 bales being of the same order as that of the Anglo-Egyptian Sudan. In the next five years the efforts of the Department of Agriculture in all directions should realise an annual crop of nearer 500,000 bales.

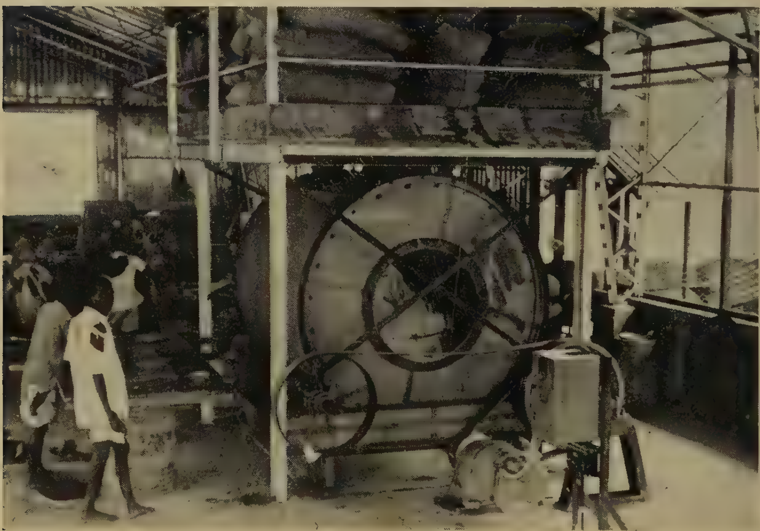
The 1949 figures for the value of domestic exports from East African territories serve well to illustrate the economic importance of the Uganda cotton crop.

	Kenya	Uganda	Tanganyika	Total
Value of cotton lint exports % of total ...	£248, 374 1.3	£17,340,215 88.3	£2,059,779 10.4	£19,648,368
Total value of all domestic exports % of total ...	£10,964,134 20.4	£23,433,182 43.7	£19,233,150 35.9	£53,630,466

1. Native cotton plot, Teso district, Eastern Province, Uganda

2. Cotton seed dressing trial, Serere Experiment Station, Uganda

3. *Cotton plant crippled with blackarm disease. Plants on the right show angular leaf spot symptoms of the disease*



4. *Experimental cotton seed dressing plant, Kampala, Uganda (safety guards removed for the purpose of taking the photograph)*

The Uganda crop is almost entirely roller-ginned, the ginneries being largely in the hands of Indians. The main buyers of the lint are India and Lancashire with small amounts going to Italy, Spain and other countries.

The annual acreage of land under cotton cultivation in Uganda varies considerably from year to year according to the season and the cultivators' preoccupation with the planting of food crops, but in recent years has been around the 1½ million mark. The average size of a cotton plot is just under an acre, a cultivator and his family having a " shamba " of between four to ten acres.

Planting of cotton in the Protectorate extends over a period from May to August, depending on the district and the advent of the main rains. The land is cleared from bush and weeds by hand hoeing and, in the Eastern Province particularly, simple ox-drawn ploughs are commonly used.

A few seeds, ideally three to five, but often ten or more, are dropped by hand into shallow holes dug with rough-pointed sticks and covered in afterwards by foot. The holes are spaced at approximately one foot in the rows and three feet between the rows. Germination is rapid and the plants are thinned down to one or two plants per hole when they are 3 ins. to 10 ins. high, ideally as soon as possible but in practice often tardy.

Depending on the season and the inclination of the cultivator, the cotton receives two or three weedings by hand hoe before the picking season commences in October and onwards. In some areas picking of seed cotton is done on a communal basis, the help of neighbours being repaid by a feast and quantities of home-brewed beer.

In the main cotton zones, the cotton buying season opens in January and carries on until sometime in March. The cultivator takes his own lot of seed cotton to the nearest ginnery or cotton store, where it is bought by the agents of the ginnery owners at a fixed price laid down by the Government. The price paid to the cultivator for clean mature seed cotton (' safi ') from the 1951/52 crop was 50 cents (sixpence) per lb.

Yields vary widely throughout the country and may range from 250 lbs. of seed cotton an acre in the drier and poorer parts of the Eastern Province to 500 lbs. an acre or more in the lush and fertile Buganda Province.

Any considerable expansion in the acreage of land under cotton cultivation is not thought to be possible and would interfere with food crop production. Some areas may be cleared of tsetse fly and people re-settled there, but this process will undoubtedly be slow.

Consequently, every effort is being made by the Department of Agriculture to increase the average yield of seed cotton per acre by encouraging improved methods of cultivation, recommending optimum planting dates and by breeding of new improved varieties with better yielding powers combined with resistance to disease.

An outstanding example of recent breeding work in Uganda is the variety S 47, which yields well under a range of conditions and has considerable resistance to Blackarm disease.

Breeding work is necessarily slow, however, and as an immediate measure toward the control of Blackarm disease the Department of Agriculture in 1948 invited the assistance of commercial firms in the finding of a safe and efficient chemical seed treatment.

Blackarm is the name given to a seed-borne bacterial disease of cotton which may cause severe crippling of young plants by girdling and destroying the main stem, bringing about a serious reduction in yield. On the leaves the typical angular leaf spot lesions are produced. The infection may spread from the leaves down the petioles to the branches, preventing their further development. This results in an insidious and serious loss due to non-production of further flowers and bolls. Early infection of parts of the flowers and of the boll-wall causes considerable direct losses in productivity as well as serious staining and weakening of the lint in bolls which actually do mature.

I.C.I. responded to the appeal for assistance and some preliminary field trials were carried out in Uganda in 1949. The results formed the basis for an extensive 3-years programme of work undertaken jointly by the Department of Agriculture and I.C.I. at the Department's Agricultural Experiment Station at Serere.

Large numbers of seed dressing formulations sent from the I.C.I. Hawthorndale Laboratories, England, were tested in each season against Blackarm disease in the field. Yield trials were laid down with the more promising dressings and the various factors affecting the efficiency of seed dressings were examined.

It was not until bulk-scale seed dressing trials using 'Perenox' were carried out in the adjoining district of Teso that the full value of seed treatment became apparent. The 1950/51 crop in that district was almost double the average for the previous 27 years and it was calculated that the credit for this was shared about equally between the new variety S 47 and seed dressing. At the prices of cotton lint then prevailing, this additional return was equivalent to a sum of over £1 million.

As a result of this joint work it has been decided that the entire supply of cotton seed (approximately 19,000 tons) for planting in Uganda shall be treated annually with a cuprous oxide seed dressing. This is to be done in 11 or 12 horizontal drum mixers situated at strategic points throughout the cotton growing areas of the country and should come about in 1954.

Such a measure should make a substantial contribution towards increasing the production of cotton in the Protectorate and may have a profound influence on the economy of the whole country. In a recent speech, His Excellency the Governor of Uganda, Sir Andrew Cohen, has pronounced it to be one of the most important agricultural developments taking place in the British Colonies.

The ginning industry of Uganda has long been the subject of criticism from many quarters. The general standard of ginning is low and lint quality varies greatly. There are at present 193 ginneries in the country and this is considered to be far too many to be organised efficiently and run economically.

Under legislation introduced recently, thirty-five of the existing ginneries will be declared redundant and a further twenty will be bought by the Government for handing over to registered African co-operative societies.

Every encouragement is to be made towards the entry of Africans into the industry and training schools are to be set up in which there will be held courses of instruction in ginnery machinery, management and maintenance.

Existing ginneries will be asked to make considerable changes and improvements to buildings and equipment to bring them up to a set standard so that the industry as a whole will be run as efficiently as possible and be capable of producing a high uniform quality of lint that is satisfactory to the needs of the buyer.

TECHNICAL BREVITIES

This section includes information on plant protection problems in their widest sense, which has been obtained from published literature. We give references to the publications concerned.

INSECTICIDES

WHITE GRUB CONTROL ON PERMANENT PASTURE

IN the United Kingdom larvae of the garden chafer, *Phyllopertha horticola*, damage permanent grass on chalk and limestone soils, and the damage is aggravated by birds pulling out loose turf in their search for the grubs. The pest is of economic importance in parts of Dorset and has been troublesome in Somerset and Wiltshire. Trials indicate that dusting with 3.5% BHC at 70 lb. per acre may give good control if done about a week before the first beetles appear and in favourable weather. Birds did not pull up the turf on treated plots, possibly because there were fewer larvae or the BHC made the area unattractive to birds.

Wadsworth, S. M., Plant Path. 1952, 1 (4) : 132-133.

MEADOW SPITTLEBUG CONTROL

Spraying meadows in Ohio with BHC at an early stage of development of the meadow spittle bug, *Philaenus leucophthalmus*, gives good control without leaving any residue on the harvested crop. The optimum time of action is one week after the first nymphs appear. No other insecticide applied early gave effective control. Another way of avoiding insecticidal residues on the crop is to apply DDT in the autumn to new seedlings. This destroys adults before egg laying and reduced the nymphs in the following year, but it does not give such good results as the springtime use of BHC.

Weaver, C. R., Bull. Ohio Agric. Exp. Sta. No. 725, 1953 : 62-63.

SPIDER MITE CONTROL BY ' SYSTOX ' ON WHEAT

In Texas an infestation of the spider mite, *Petrobia latens*, on wheat 6 to 8 inches high was reduced to nil or near it for 9 days after spraying ' Systox ' at 0.47 to 0.63 lb. per acre or parathion at 0.26 to 0.31 lb. per acre. ' Systox ' persisted longer and kept the population to about 50% for 23 days. Organic sulphurs (Sulphenone and Aramite) and Metacide were less effective.

Daniels, N.E., Progr. Rep. Texas Agric. Exp. Sta. No. 1476 : 1952, *pp.* 5.

APPLE BARK BORER CONTROL

In Virginia, larvae of a clear-winged moth, *Thamnosphecia pyri*, called the apple bark borer or pear borer, injure trees by feeding in the bark and cambium of the trunks and larger branches. Of various compounds tested for control, the most effective were parathion and EPN. It is recommended that two sprays should be applied each year for two years during the egg-laying period using 15% parathion at 3 lb. per 100 gal. or EPN 300 at 2 lb. per 100 gal. and thoroughly covering the trunks and lower branches.

Woodwide, A. M., Bull. Va. Agric. Exp. Sta., No. 452, 1952, *pp.* 15.

CABBAGE ROOT FLY CONTROL

In the United Kingdom excellent control of the cabbage root fly, *Erioischia brassicae*, was obtained by applying to the soil at the base of cabbage plants BHC 50% wettable powder at 2 oz. per 5 gal. water, using 1 fl. oz. per plant as soon as the crop had been singled—by which time egg-laying had begun. Treated plots had nearly a full stand, whereas the controls lost about half the plants. A tar oil wash did not give commercial control. Cost of the BHC treatment was 4/- an acre for materials as against nearly £4 for a single application of calomel dust.

Moreton, B. O. and Light, W. I. St. G., Plant Path. 1952, **1** (4) : 121.

'SYSTOX' AS A SYSTEMIC APHICIDE : REPELLENT EFFECT

In greenhouse tests in Germany, the Bayer-Leverkusen product 8169* at 0.05% was taken up by the roots of eye-stecklings of the potato and gave complete kills of the aphid *Myzodes* (*Myzus*) *persicae* three days after application. It remained effective for at least one month in potted potato plants dosed at 100 ml. per plant with a 0.05% solution ; dosages up to 300 ml. per plant of 0.1% concentration gave no better result. The material readily penetrated leaves and a 0.05% solution applied to a single leaf made the whole plant aphicidal, but the effect fell off after 7 days. Like E 605 forte, it appears in the guttation drops a few hours after its application, which partly explains the decrease in time in insecticidal efficiency. Plants that have taken up 8169 seem to have a repellent effect : aphids that had been starved for 12 hours waited for about 10 minutes before they would suck from the leaves of treated (watered) plants ; when 16 fed aphids were offered the choice of foliage all moved on to the untreated foliage excepting one which ran about excitedly on the leaf of a treated plant for 2 hours without having sucked up to that time. In field trials, 8169 remained aphicidal for a month, though rain caused some of the material to be washed out of the leaves and soil.

* Now marketed as 'Systox.'

Hofferbert, W. and Orth, H., Höfchen Briefe, 1952, **5** (1) : 10-15.

SYSTEMIC INSECTICIDES AGAINST HOP PESTS: EFFECTS ON HOP AND BEER QUALITY

Hop red spider, *Epitetranychus althaeae* (*Tetranychus telarius*) is effectively controlled in Germany by foliage spraying with 'Systox' at 0.01% or schradan at 0.075%. 'Systox' is more persistent than schradan, kills quicker, and destroys the eggs. Degree of persistency is related to time of treatment and age of plant. When sprayed before flowering, 'Systox' was effective for 4 to 5 weeks whereas schradan persisted 3 to 4 weeks. Spraying at flowering time gave corresponding persistency periods of 3 to 3½ weeks and 2½ to 3 weeks. For sprays applied between full flowering and fruiting, the figures were 2 and 1 to 1½ weeks respectively. It is recommended, therefore, to spray early, preferably before attack. Spraying the under surfaces of leaves gave better action and greater persistency than spraying the upper surfaces, for the under surfaces alone have stomata and penetration is better. Soil applications were less satisfactory than foliage spraying, owing partly to the risk of drying out. A Bayer product, No. 8224, at 0.01 to 0.1% gave 100% kill of mites three hours after spraying, and it had a good ovicidal action at 0.1%. Against hop aphid, *Phorodon humulis*, both 'Systox' and schradan were effective and persisted for at least four weeks, a concentration of 0.005% 'Systox' being adequate. This concentration was not enough to control mites. There was no plant injury from 'Systox' at 0.05% or schradan at 0.075%; on the contrary both materials gave "physiologically conditioned" increases in hop yield of 10 to 20%. Rabbits fed for five weeks on hop foliage from 'Systox'-sprayed plants showed no signs of toxicity. No 'Systox' could be detected in "cones" from plants that had been sprayed with 0.5% 'Systox' 14 days before harvesting, using mosquito larvae (*Aedes aegyptii*), which are sensitive to 0.001% of the active principle, as the test organism. Aroma and the humulin content of "cones" were slightly affected by 'Systox' or schradan only when applications were made 14 days before harvest; but treatment so late is unnecessary. Beer-manufacturing processes and the flavour of beer were unaffected.

Zattler, F., *Höfchen Briefe*, 1951, 4 (4) : 131-169.

CANE GRUB CONTROL: EFFECT OF MIXING BHC WITH FERTILIZER

In Queensland it is recommended that BHC in the amounts required for control of the cane grub (*Dermolepida albohirtum*) should not be mixed with fertilizer. Separate applications should be made in such a way that fertilizer and BHC will not be placed in the same position in the soil. These conclusions are based on experiments in progress using BHC equivalent to 75 lb. of 20% dust per acre and fertilizer at 4 cwt. per acre. When BHC and fertilizer was applied at planting time above the protected plant cane in the drill, growth and stooling suffered. It is estimated that about 50% of the benefit of the

fertilizer was lost in comparison with plots where the BHC was separately applied after the cane was established and the fertilizer was applied at planting time in the same position as the mixture. BHC and fertilizer gave better growth than no fertilizer. Rock phosphate is still preferred to inert materials as a diluent for BHC.

Wilson, G., Cane Gr. Quart. Bull. 1951, **15** (1) : 18-21.

FRENCHI GRUB CONTROL IN PLANT CANE

In Queensland the frenchi grub (*Lepidiota frenchi*) is prepared in its third stage to inflict severe damage on sugar cane roots as soon as it rises from the subsoil. To ensure its rapid and economic destruction at this stage enough BHC must be applied where vulnerable parts of the cane stool will be protected, and in as limited a zone of soil as possible. Best results are obtained by placing BHC in a band 6 to 8 inches wide just above the cane sett when planting, after very slightly covering the setts with soil. On severely attacked fields, complete control was given by BHC at the rate of 300 lb. of a 10% dust per acre, and 80% by 150 lb. per acre, applied in this way. Control of frenchi, however, is more likely to be required in the younger stages and this, along with greyback grub control, can be effected by applying BHC in the half-open drill after the cane is established.

Wilson, G., Cane Gr. Quart. Bull. 1951, **15** (1) : 25-28.

WHITE STEM BORER OF COFFEE CONTROL

White stem borer of coffee, *Xylotrechus quadripes*, was well controlled by 'Agrocide' Dispersible Powder (BHC, 6.5% gamma isomer) mixed in water at 8 lb. per 42 gal. and applied to the stems of arabica coffee with a piece of gunny, using 2½ to 3½ lb. 'Agrocide' per acre of 1,200 trees. Applications were made in mid-October, November, and, to counteract emergence of the beetle in hot weather, in April. Treatment for two years of a 120-acre estate reduced the annual removal of bored trees from about 4,000 to 200 trees.

Morris, J. G. L., Mon. Bull. Indian Coffee Bd. 1952, **16** (10) : 194.

FUNGICIDES

SPRAY CONCENTRATES FOR TOMATO DISEASE CONTROL

Copper and zineb sprays at four times the usual concentration and one-fourth as many gallons to the acre gave as good control of *Septoria* blight as normal strengths of these materials without injuring the plants. Application was made by reducing pump pressure in proportion to increasing concentration, and by using lower capacity nozzles.

Samson, R. *W.*, 65*th Rep. Ind. Agric. Exp. Sta.*, 1952 : 34-35.

VEGETABLE DISEASE CONTROL BY COPPER FUNGICIDES

In Malaya satisfactory control of potato blight (*Phytophthora infestans*), celery leaf spot (*Septoria apii-graveolentis*), and French bean anthracnose (*Colletotrichum lindemuthianum*) was obtained by spraying at weekly intervals to harvest time with 0.5% 'Perenox' or 0.5% Shell Copper Fungicide. Good control of carrot leaf blight (*Alternaria dauci*) was obtained by weekly spraying with 0.25% 'Perenox.' In all trials, spraying increased yields. The interval between sprayings should not be longer than one week. Bordeaux mixture was as effective as the other fungicides, but more troublesome to prepare and apply.

Johnston, A., Malay. Agric. J. 1953, **36** (1) : 28-35.

BROWN RUST OF WHEAT CONTROL

Brown rust of wheat (*Puccinia triticina*) can be controlled in Yugoslavia by spraying wheat with sulphur compounds before heading, after flowering, and before wax ripeness. In rainy seasons the number of sprayings must be increased. 'Sulfinette' (calcium polysulphide) at 1% left the leaves completely free from uredospores. Colloidal sulphur and Dufar also gave good results. Bordeaux mixture was poorer. 'Fosferno' 20 and lead arsenate were ineffective.

Lucic, S., Plant Prot. (Belgrade), 1952 (12) : 43-48.

HEAD-SMUT OF MAIZE CONTROL

In Yugoslavia the chlamydospores of head-smut of maize, *Sorosporium reilianum*, do not germinate unless they have a resting period of 3 to 4 months and, in nature, few of the autumn-formed spores germinate until April or May when maize is sown. Early sowing reduces the possibility of infection. Seed dressing with an organic mercurial or copper carbonate can control the disease. It is believed that chlamydospores which rest in the field are more important for natural infection of maize than seed-borne chlamydospores.

Kispatic, J. and Lusin, V., Plant Prot. (Belgrade), 1952, (12) : 18-29.

SOME OBSERVATIONS ON CITRUS CANKER IN ASSAM

Further experiments on the control of citrus canker (*Xanthomonas citri*) were carried out at the Plant Pathological Laboratory, Jorhat, Assam, in 1950, using Bordeaux mixture (4-6-50), Bordeaux oil emulsion and 'Perenox' (4 lb. per 100 gal.). The fungicides were applied after each of the four flushes and effective control of the disease was obtained with each product, control being further improved by the addition of a sticker (resin or 'Albolenum' = 'Alboleum' ?). On untreated trees infection was severe. The above-

mentioned treatments should be preceded by the removal and burning of the affected twigs and sterilization of the soil around the plants by a flame-thrower.

Chowdbury, S., Sci. & Cult., **18** : 5 : 246-248 : 1952. *Via Rev. App. Myc.* **32** : 4 : 183-4 : 1953.

MISCELLANEOUS

VIRUS TRANSMISSION BY GRASSHOPPERS

In Nebraska it is shown that the differential grasshopper, *Melanoplus differentialis*, can transmit tobacco mosaic, potato ringspot, and tobacco ringspot viruses from tobacco to tobacco. Buccal fluid of the grasshopper inhibits infectivity of the viruses, but these remain infective in it for several hours. Virus was detected in the faeces.

Walters, H. J., Phytopathology, 1952, **42** (7) : 355-362.

ROOT KNOT EELWORM INFESTATION AND POTASSIUM NUTRITION OF THE HOST

Studies in host parasite relations of the root-knot nematode, *Meloidogyne incognita*, and lima bean plants indicate that nematode damage is correlated with the amount of potassium available to the host. This suggests that the nematodes interfere with potassium nutrition of the plant and thus may cause marked injury when introduced to plants deficient in potassium. Damage may be reduced by increasing the level of potassium supplied to plants. These effects may be due to reduction of the root systems of infected plants, interference with translocation of nutrients, and possible differential absorption of potassium by the plants owing to use of this element by the nematodes in their nutrition and egg production.

Oteifa, B. A., Proc. Helm. Soc. Wash. 1952, **19** (2) : 99-104.

SWOLLEN SHOOT OF CACAO CONTROL

A. Casely-Hayford, Gold Coast Minister of Agriculture and Natural Resources, has reported that by December 1952 over 16 million cacao trees had been cut out since the campaign against swollen shoot disease began. In Ashanti, where nearly half of the country's cacao comes from, complete control is in sight. In the E. and W. Provinces, progress has not been as great as it should be. Local and Amazonian varieties are being distributed free to farmers. Capsid attack—' Black pod disease '—which annually causes the industry a loss of 20% of its yield, is now a more serious danger than swollen shoot. It is easily controlled in young trees by painting with ' Kumakate ' (DDT) and experiments are in hand to find a way of controlling the trouble in fully grown trees.

New Commonw. 1953, **25** (5) : 249.

ERRATUM

Under " SWOLLEN SHOOT OF CACAO CONTROL "
8th line: DELETE: ' Black pod disease. '

PRINTED IN ENGLAND BY
THE CLUNBURY PRESS,
BERKHAMSTED, HERTS.
C11142